

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

16  
REC'D 25 JUL 2000

Applicant's or agent's file reference P-2450-PC	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IL99/00227	International filing date (day/month/year) 02/05/1999	Priority date (day/month/year) 01/05/1998
International Patent Classification (IPC) or national classification and IPC H04N7/10		
Applicant LIBIT SIGNAL PROCESSING LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  01/12/1999	Date of completion of this report  21.07.2000
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Noll, B  Telephone No. +49 89 2399 8700  

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL99/00227

## I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

### Description, pages:

1-14 as originally filed

### Claims, No.:

1-30 as originally filed

### Drawings, sheets:

1/13-13/13 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

## IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☒ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL99/00227

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
- ☒ not complied with for the following reasons:

**see separate sheet**

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- ☒ all parts.
- ☐ the parts relating to claims Nos. .

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes:	Claims	6,8-16,21-30
	No:	Claims	1-4,7,17-20
Inventive step (IS)	Yes:	Claims	23-30
	No:	Claims	6,8-16,21,22
Industrial applicability (IA)	Yes:	Claims	1-30
	No:	Claims	

### 2. Citations and explanations

**see separate sheet**

## VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/IL99/00227

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**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**To section IV:**

The subject-matter of claims 1-4, 7 and 17-20 is substantially known from the document WO-A-97 16046 (hereinafter referred to as D1), see section V below. The features of claims 5, 6, 8-16, 21 and 22 relate to a transmission arrangement and method, a communication system and method and a front end including a particular filter arrangement (claims 5 and 8) in the transmitter and the receiver to minimize adjacent channel interference in the signal.

Claims 23-30 relate to a communication arrangement and method wherein a data symbol or a FEC block is reproduced N times and each reproduced symbol or FEC block is transmitted using a distinct transmission channel. In the receiver soft-combination is applied to all received symbols or blocks to provide an output of the original symbol or block.

The two groups of claims mentioned above are based on totally different technical concepts and do therefore not establishing a common inventive concept in the sense of Rule 13.2 PCT. Therefore, the application does not meet the requirement of Rule 13.1 PCT.

**To section V:**

With regard to claim 1 the document D1 discloses a transmission arrangement for transmitting a data signal using a cable tv transmission medium (see abstract and figure 1). The arrangement includes an encoder 12-24 to encode an input data stream 10 as an encoder output signal, a transmission filter arrangement 26 to reduce adjacent channel interference in the encoder output signal (see page 16, first paragraph) and a modulator 28 to generate a modulated rf signal for transmission through the cable (see page 19, from last paragraph onwards). Hence all features of claim 1 can be identified in D1.

The additional features of claims 2-4 are also known from D1, see page 13, lines 6-10 and from line 19 onwards.

The features of claims 5 and 6 of arranging for a particular filter do not exceed the nor-

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/IL99/00227

mal system design capabilities of a skilled person and do therefore not add anything inventive.

Claim 7 is directed to a communication system and includes all features of claim 1 and, in addition, the feature of a receiver arrangement. A receiver for recovering the data from the modulated signal is likewise mentioned in D1, see page 11, lines 15-19, page 13, lines 15-18, page 14, from line 4 onwards and multiple passages after page 18, line 17. Hence the features of claim 7 are likewise known from D1.

The features of claim 8 are generally known in the art of receivers (frontend, decoder) or correspond to those of claims 5 and 6 (filter and equalizer) and do therefore not add anything inventive. The same applies for claim 15 which is identical to claims 7 + 8.

The features of claims 9-14 are considered as mere design choices which are routinely selected by a skilled person.

Claim 16 is directed to a front end arrangement per se and corresponds to the features mentioned in claims 9 + 10. For the reasons above, it is likewise considered as the result of mere design choice.

Method claims 17-22 correspond to claims 1-3, 7, 8 and 10 in terms of method features. Therefore, the above objections against claims 1-3, 7, 8 and 10 also hold for claims 17-22 for the same reasons.

None of the available prior art discloses or renders obvious the features of claims 23-30 directed to a system and method for communicating a data signal wherein a symbol of FEC block is reproduced N times, each copy is transmitted by a distinct transmission channel and performing soft-combining of received signals in the receiver.

There are no objections concerning industrial applicability.

Hence the subject-matter of claims 23-30 meets the requirements of Article 33(2)-(4) PCT.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/IL99/00227

**To section VII:**

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6.2(b) PCT. This applies to both the preamble and characterising portion.

To meet the requirements of Rule 5.1(a)(ii) PCT, the document mentioned above should have been identified in the description and the relevant background art disclosed therein should have been briefly discussed.

**To section VIII:**

The claims are not concise (Article 6 PCT): Claim 7 is worded as independent claim although it comprises all features of claim 1. Claim 15 is a mere repetition of the features of claims 7 and 8.

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>P-2450-PC</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/IL 99/ 00227</b>	International filing date (day/month/year) <b>02/05/1999</b>	(Earliest) Priority Date (day/month/year) <b>01/05/1998</b>
Applicant <b>LIBIT SIGNAL PROCESSING LTD. et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

4



None of the figures.



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 99/00227

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 H04N7/10 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04N H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X J	WO 97 16046 A (ANDERSON STEVEN E ; GEN INSTRUMENT CORP (US); HOU VICTOR T (US); K0) 1 May 1997 (1997-05-01) page 9, line 5 - page 16, line 15; figure 1	1-4, 7, 17-20
A	---	5, 6
A J	WO 97 41691 A (PHILIPS ELECTRONICS NV ; PHILIPS NORDEN AB (SE)) 6 November 1997 (1997-11-06) page 8, line 27 - page 9, line 3; figures 5, 6	1, 2, 7, 17, 18, 20
A	---	
A	US 5 710 797 A (SEGAL MORDECHAI ET AL) 20 January 1998 (1998-01-20) cited in the application the whole document ---	
	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance  
 "E" earlier document but published on or after the international filing date  
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  
 "O" document referring to an oral disclosure, use, exhibition or other means  
 "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  
 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone  
 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.  
 "&" document member of the same patent family

Date of the actual completion of the international search

16 August 1999

Date of mailing of the international search report

23/08/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Beaudoin, 0

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 99/00227

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A ✓	WO 97 49171 A (SYMMETRICOM INC) 24 December 1997 (1997-12-24) page 6, line 3 - page 4, line 4; figures 3C,4,5 ----	16
A ✓	EP 0 748 124 A (DISCOVISION ASS) 11 December 1996 (1996-12-11) page 10, line 49 - page 11, line 15; figures 4A,4B page 19, line 26 - page 20, line 5 ----	8,15,21
A ✓	WO 91 18458 A (SECR DEFENCE BRIT) 28 November 1991 (1991-11-28) page 2, line 1 - page 4, line 9 ----	23,27
A ✓	EP 0 449 327 A (NIPPON ELECTRIC CO) 2 October 1991 (1991-10-02) the whole document -----	23,27

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IL 99/00227

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9716046 A	01-05-1997	AU 706233 B AU 7466596 A CN 1203013 A EP 0857400 A NO 981829 A	10-06-1999 15-05-1997 23-12-1998 12-08-1998 23-06-1998
WO 9741691 A	06-11-1997	US 5881363 A EP 0835587 A	09-03-1999 15-04-1998
US 5710797 A	20-01-1998	AU 5859496 A CA 2221828 A EP 0827652 A WO 9637981 A	11-12-1996 28-11-1996 11-03-1998 28-11-1996
WO 9749171 A	24-12-1997	US 5764704 A AU 3398497 A CA 2258009 A EP 0906656 A ZA 9705328 A	09-06-1998 07-01-1998 24-12-1997 07-04-1999 27-07-1998
EP 0748124 A	11-12-1996	CA 2170469 A CN 1138795 A EP 0874499 A EP 0874466 A EP 0874491 A EP 0877517 A EP 0877514 A JP 9008853 A JP 10135941 A JP 10093438 A US 5717715 A US 5635864 A US 5668831 A US 5692020 A US 5761210 A	08-12-1996 25-12-1996 28-10-1998 28-10-1998 28-10-1998 11-11-1998 11-11-1998 10-01-1997 22-05-1998 10-04-1998 10-02-1998 03-06-1997 16-09-1997 25-11-1997 02-06-1998
WO 9118458 A	28-11-1991	AT 139393 T AU 637703 B AU 7759991 A CA 2082626 A DE 69120269 D DE 69120269 T DK 527819 T EP 0527819 A GB 2259228 A,B US 5422913 A	15-06-1996 03-06-1993 10-12-1991 12-11-1991 18-07-1996 10-10-1996 01-07-1996 24-02-1993 03-03-1993 06-06-1995
EP 0449327 A	02-10-1991	JP 2591240 B JP 3283826 A JP 2591241 B JP 3283827 A CA 2039596 C DE 69129768 D DE 69129768 T US 5202903 A	19-03-1997 13-12-1991 19-03-1997 13-12-1991 13-12-1994 20-08-1998 25-02-1999 13-04-1993

# PATENT COOPERATION TREATY

WO 99/57898  
PCT/IL99/00227

**PCT**

## NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

EITAN, PEARL, LATZER & COHEN-ZEDEK  
2 Gav Yam Center  
Shenkar Street 7  
46725 Herzlia  
ISRAËL

Date of mailing (day/month/year)

11 November 1999 (11.11.99)

Applicant's or agent's file reference

P-2450-PC

### IMPORTANT NOTICE

International application No.

PCT/IL99/00227

International filing date (day/month/year)

02 May 1999 (02.05.99)

Priority date (day/month/year)

01 May 1998 (01.05.98)

Applicant

LIBIT SIGNAL PROCESSING LTD: et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:

AU,CN,EP,IL,JP,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,  
HU,ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RQ,RU,  
SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZA,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 11 November 1999 (11.11.99) under No. WO 99/57898

### REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

### REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

J. Zahra

Telephone No. (41-22) 338.83.38

PCT

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Eitan Pearl Latzer & Cohen-Zedek  
2 Gav Yam Center  
7 Shenkar Street  
Herzlia 46725  
ISRAEL

NOTIFICATION OF RECEIPT  
OF DEMAND BY COMPETENT INTERNATIONAL  
PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(e) and 61.1(b), first sentence  
and Administrative Instructions, Section 601(a))

Date of mailing  
(day/month/year)

13.12.99

Applicant's or agent's file reference  
P-2450-PC

IMPORTANT NOTIFICATION

International application No.

PCT/IL 99/00227

International filing date (day/month/year)

02/05/1999

Priority date (day/month/year)

01/05/1998

Applicant

LIBIT SIGNAL PROCESSING LTD. et al.

1. The applicant is hereby **notified** that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

01/12/1999

2. This date of receipt is:

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).  
☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).  
☐ the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. ☐ **ATTENTION:** That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA:



European Patent Office  
D-80298 Munich  
Tel. (+49-89) 2399-0, Tx: 523656 cpmu d  
Fax: (+49-89) 2399-4465

Authorized officer

COMTE C S J

Tel. (+49-89) 2399-8598



## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P-2450-PC	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IL99/00227	International filing date (day/month/year) 02/05/1999	Priority date (day/month/year) 01/05/1998
International Patent Classification (IPC) or national classification and IPC H04N7/10		
Applicant LIBIT SIGNAL PROCESSING LTD. et al.		

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2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.18 and Section 607 of the Administrative Instructions under the PCT).

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3. This report contains Indications relating to the following items:

- ☒ Basis of the report
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  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☒ Lack of unity of invention
  - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☒ Certain defects in the international application
  - VIII ☒ Certain observations on the international application

Date of submission of the demand  01/12/1999	Date of completion of this report  21.07.2000
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523858 epmu d Fax: +49 89 2399 - 4485	Authorized officer  Noll, B  Telephone No. +49 89 2399 8700 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/IL99/00227

**I. Basis of the report**

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

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1-14 as originally filed

**Claims, No.:**

1-30 as originally filed

**Drawings, sheets:**

1/13-13/13 as originally filed

**2. The amendments have resulted in the cancellation of:**

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

**4. Additional observations, if necessary:****IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.  
☒ paid additional fees.  
☐ paid additional fees under protest.  
☐ neither restricted nor paid additional fees.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/IL99/00227

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
- ☒ not complied with for the following reasons:
- see separate sheet**
4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- ☒ all parts.
- ☐ the parts relating to claims Nos. .

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Yes: Claims 6,8-16,21-30
	No: Claims 1-4,7,17-20
Inventive step (IS)	Yes: Claims 23-30
	No: Claims 6,8-16,21,22
Industrial applicability (IA)	Yes: Claims 1-30
	No: Claims

**2. Citations and explanations****see separate sheet****VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**International application No. PCT/IL99/00227

---

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IL99/00227

**To section IV:**

The subject-matter of claims 1-4, 7 and 17-20 is substantially known from the document WO-A-97 16046 (hereinafter referred to as D1), see section V below. The features of claims 5, 6, 8-16, 21 and 22 relate to a transmission arrangement and method, a communication system and method and a front end including a particular filter arrangement (claims 5 and 8) in the transmitter and the receiver to minimize adjacent channel interference in the signal.

Claims 23-30 relate to a communication arrangement and method wherein a data symbol or a FEC block is reproduced N times and each reproduced symbol or FEC block is transmitted using a distinct transmission channel. In the receiver soft-combination is applied to all received symbols or blocks to provide an output of the original symbol or block.

The two groups of claims mentioned above are based on totally different technical concepts and do therefore not establishing a common inventive concept in the sense of Rule 13.2 PCT. Therefore, the application does not meet the requirement of Rule 13.1 PCT.

**To section V:**

With regard to claim 1 the document D1 discloses a transmission arrangement for transmitting a data signal using a cable tv transmission medium (see abstract and figure 1). The arrangement includes an encoder 12-24 to encode an input data stream 10 as an encoder output signal, a transmission filter arrangement 26 to reduce adjacent channel interference in the encoder output signal (see page 16, first paragraph) and a modulator 28 to generate a modulated rf signal for transmission through the cable (see page 19, from last paragraph onwards). Hence all features of claim 1 can be identified in D1.

The additional features of claims 2-4 are also known from D1, see page 13, lines 6-10 and from line 19 onwards.

The features of claims 5 and 6 of arranging for a particular filter do not exceed the nor-

**INTERNATIONAL PRELIMINARY**

International application No. PCT/IL99/00227

**EXAMINATION REPORT - SEPARATE SHEET**

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mal system design capabilities of a skilled person and do therefore not add anything inventive.

Claim 7 is directed to a communication system and includes all features of claim 1 and, in addition, the feature of a receiver arrangement. A receiver for recovering the data from the modulated signal is likewise mentioned in D1, see page 11, lines 15-19, page 13, lines 15-18, page 14, from line 4 onwards and multiple passages after page 18, line 17. Hence the features of claim 7 are likewise known from D1.

The features of claim 8 are generally known in the art of receivers (frontend, decoder) or correspond to those of claims 5 and 6 (filter and equalizer) and do therefore not add anything inventive. The same applies for claim 15 which is identical to claims 7 + 8.

The features of claims 9-14 are considered as mere design choices which are routinely selected by a skilled person.

Claim 16 is directed to a front end arrangement per se and corresponds to the features mentioned in claims 9 + 10. For the reasons above, it is likewise considered as the result of mere design choice.

Method claims 17-22 correspond to claims 1-3, 7, 8 and 10 in terms of method features. Therefore, the above objections against claims 1-3, 7, 8 and 10 also hold for claims 17-22 for the same reasons.

None of the available prior art discloses or renders obvious the features of claims 23-30 directed to a system and method for communicating a data signal wherein a symbol of FEC block is reproduced N times, each copy is transmitted by a distinct transmission channel and performing soft-combining of received signals in the receiver.

There are no objections concerning industrial applicability.

Hence the subject-matter of claims 23-30 meets the requirements of Article 33(2)-(4) PCT.

**INTERNATIONAL PRELIMINARY**

International application No. PCT/IL99/00227

**EXAMINATION REPORT - SEPARATE SHEET**

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**To section VII:**

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6.2(b) PCT. This applies to both the preamble and characterising portion.

To meet the requirements of Rule 5.1(a)(ii) PCT, the document mentioned above should have been identified in the description and the relevant background art disclosed therein should have been briefly discussed.

**To section VIII:**

The claims are not concise (Article 6 PCT): Claim 7 is worded as independent claim although it comprises all features of claim 1. Claim 15 is a mere repetition of the features of claims 7 and 8.

## PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Eitan Pearl Latzer & Cohen-Zedek  
2 Gav Yam Center  
7 Shenkar Street  
Herzlia 46725  
ISRAEL

PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

Date of mailing  
(day/month/year) 21.07.2000

Applicant's or agent's file reference  
P-2450-PC

## IMPORTANT NOTIFICATION

International application No.  
PCT/IL99/00227

International filing date (day/month/year)  
02/05/1999

Priority date (day/month/year)  
01/05/1998

Applicant  
LIBIT SIGNAL PROCESSING LTD. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the International preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

## 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPO/EU



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

SCHALINATUS, D

Tel. +49 89 2399-8242



# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY

To:

Eitan Pearl Latzer & Cohen-Zedek  
2 Gav Yam Center  
7 Shenkar Street  
Herzlia 46725  
ISRAEL

## PCT

INVITATION TO RESTRICT OR  
TO PAY ADDITIONAL FEES

(PCT Article 34(3) (a) and Rule 68.2)

Date of mailing (Day/month/year)      03.02.2000	
Applicant's or agent's file reference P-2450-PC	<b>REPLY OR PAYMENT DUE</b> within 1 month(s) from the above date of mailing
International application No. PCT/IL99/00227	International filing date (day/month/year) 02/05/1999
Priority date (day/month/year) 01/05/1998	
International Patent classification (IPC) or national Patent classification: H04N7/10	
Applicant LIBIT SIGNAL PROCESSING LTD. et al.	

**1. This International Examining Authority**

- (i) considers that **the international application does not comply with the requirements of unity of invention** (Rule 13.1, 13.2 and 13.3) for the reasons indicated in the Annex.
- (ii) therefore considers that there are **2 inventions** claimed in the international application as indicated in the Annex.
- (iii) recalls that claims relating to inventions in respect of which no international search report has been established need not be the subject of international preliminary examination (Rule 66.1 (e)).


**2. Consequently the applicant is hereby invited, within the time limit indicated above, to restrict the claims as suggested under item 3, below, or to pay the amount indicated below:**

$$\begin{array}{rcccl}
 \text{EUR } 1533.00 & & 2 & & \text{EUR } 3066.00 \\
 \text{Fee per additional invention} & \times & \text{number of additional inventions} & = & \text{total amount of additional fees}
 \end{array}$$

The applicant is informed that, according to Rule 68.3 (c), **the payment of any additional fee may be made under protest**, i.e. a reasoned statement to the effect that the international application complies with the requirement of unity of invention or that the amount of the required additional fee is excessive.

- 3. If the applicant opts to restrict the claims**, this Authority suggests the restriction possibilities indicated in the Annex, which in its opinion would be in compliance with the requirement of unity of invention.
- 4. In the absence of any response** from the applicant, this Authority will establish the international preliminary examination report on those parts of the international application indicated in the Annex which, in the opinion of this Authority appear to relate to the main invention.

Name and mailing address of the  
international preliminary examination authority:

 European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

Noll, B

Telephone No. +49 89 2399-8700



**INVITATION TO RESTRICT  
OR TO PAY ADDITIONAL FEES**

International application No. PCT/IL99/00227

The subject-matter of claims 1-4, 7 and 17-20 is substantially known from the document WO-A-97 16046 (hereinafter referred to as D1), see in particular figure 1 and corresponding parts of the description. The features of claims 5, 6, 8-16, 21 and 22 relate to a transmission arrangement and method, a communication system and method and a front end including a particular filter arrangement (claims 5 and 8) in the transmitter and the receiver to minimize adjacent channel interference in the signal.

Claims 23-30 relate to a communication arrangement and method wherein a data symbol or a FEC block is reproduced N times and each reproduced symbol or FEC block is transmitted using a distinct transmission channel. In the receiver soft-combination is applied to all received symbols or blocks to provide an output of the original symbol or block.

The two groups of claims mentioned above are based on totally different technical concepts and do therefore not establishing a common inventive concept in the sense of Rule 13.2 PCT. Therefore, the application does not meet the requirement of Rule 13.1 PCT.

The best way to overcome this objection is to file a single independent claim in each category, together with an appropriate set of dependent claims, or to delete one of the two above-mentioned set of claims.

In case the applicant maintains the claims of both groups as they are and wishes to obtain a full preliminary examination for them one additional examination fee must be paid. In case the applicant is satisfied if only the first group is examined no further action is necessary.

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>77813-5</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/CA 99/01230</b>	International filing date (day/month/year) <b>23/12/1999</b>	(Earliest) Priority Date (day/month/year) <b>23/12/1998</b>
Applicant <b>CONNAUGHT LABORATORIES LIMITED et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 8 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☒ contained in the international application in written form.

☒ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☒ Certain claims were found unsearchable (See Box I).

3. ☒ Unity of invention is lacking (see Box II).

## 4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

## 5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☐ None of the figures.



## INTERNATIONAL SEARCH REPORT

International Application No

PC 99/01230

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 C07K14/295 C12N15/31 C12N15/62 A61K48/00 C12N5/10  
 C12Q1/68 C07K16/12 A61K39/118 A61K38/16 C07K19/00  
 C12P21/00 G01N33/569

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C12N C07K A61K C12Q G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE GENEMBL [Online]            22 July 1998 (1998-07-22)            STEPHENS ET AL: "Chlamydia trachomatis            section 45 of 87 of the complete genome"            XP002133142            Accession AE001318            -&amp; STEPHENS ET AL: "Genome Sequence of an            Obligate Intracellular Pathogen of Humans:            Chlamydia trachomatis"            SCIENCE,            vol. 282, 23 October 1998 (1998-10-23),            pages 754-759, XP002104802            ---            -/--</p>	1-12, 15-30



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*&\* document member of the same patent family

Date of the actual completion of the international search

20 March 2000

Date of mailing of the international search report

31. 5. 00

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

ALCONADA RODRIG., A

## INTERNATIONAL SEARCH REPORT

International Application No

PCT 99/01230

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	<p>WO 99 27105 A (GRIFFAIS REMY ;GENSET (FR))  3 June 1999 (1999-06-03)  page 5, line 6 -page 6, line 20  page 13, line 34 -page 14, line 3  page 46, line 4-14  page 51, line 6 -page 54, line 28  page 56, line 30 -page 57, line 2  page 60, line 12-25  page 62, line 10 -page 66, line 4  page 68, line 25-32  page 69, line 7 -page 70, line 22  page 112  SEQ ID NO:6851  SEQ ID NO:602  claims</p>	1-12, 15-30
P,X	<p>---  DATABASE GENEMBL [Online]  15 March 1999 (1999-03-15)  KALMAN ET AL: "Chlamydia pneumoniae  section 57 of 103 of the complete genome"  XP002133143  Accession AE001641  -&amp; KALMAN ET AL: "Comparative Genomes of  Chlamydia pneumoniae and C. trachomatis"  NATURE GENETICS,  vol. 21, April 1999 (1999-04), pages  385-389, XP000853883  page 387, left-hand column</p>	1-12, 15-30
A	<p>---  GU L ET AL: "Cloning and characterization  of a secY homolog from Chlamydia  trachomatis."  MOLECULAR AND GENERAL GENETICS.,  vol. 243, no. 4, 25 May 1994 (1994-05-25),  pages 482-487, XP000864462  the whole document</p>	
A	<p>---  EP 0 784 059 A (HITACHI CHEMICAL CO LTD)  16 July 1997 (1997-07-16)</p>	
A	<p>---  MELGOSA M P ET AL: "ISOLATION AND  CHARACTERIZATION OF A GENE ENCODING A  CHLAMYDIA PNEUMONIAE 76-KILODALTON PROTEIN  CONTAINING A SPECIES-SPECIFIC EPITOPE"  INFECTION AND IMMUNITY,US,AMERICAN SOCIETY  FOR MICROBIOLOGY. WASHINGTON,  vol. 62, no. 3, 1 March 1994 (1994-03-01),  pages 880-886, XP002059939  ISSN: 0019-9567</p> <p>---  -/--</p>	

## INTERNATIONAL SEARCH REPORT

International Application No

PC 99/01230

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WATSON M W ET AL: "THE NUCLEOTIDE SEQUENCE OF THE 60KDA CYSTEINE RICH OUTER MEMBRANE PROTEIN OF CHLAMYDIA-PNEUMONIAE STRAIN IOL-207" NUCLEIC ACIDS RESEARCH 1990, vol. 18, no. 17, 1990, page 5299 XP000891318 ISSN: 0305-1048 ---	
A	MELGOSA M P ET AL: "SEQUENCE ANALYSIS OF THE MAJOR OUTER MEMBRANE PROTEIN GENE OF CHLAMYDIA-PNEUMONIAE" INFECTION AND IMMUNITY 1991, vol. 59, no. 6, 1991, pages 2195-2199, XP000891319 ISSN: 0019-9567 -----	

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP99/01230

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9927105	A	03-06-1999	AU 1170299 A	15-06-1999
-----				
EP 0784059	A	16-07-1997	AU 685680 B	22-01-1998
			AU 3532995 A	09-04-1996
			WO 9609320 A	28-03-1996
			JP 8143594 A	04-06-1996
			JP 9009974 A	14-01-1997
			JP 9009976 A	14-01-1997
			JP 9009999 A	14-01-1997
			JP 9015243 A	17-01-1997
			JP 9015244 A	17-01-1997
-----				

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CA 99/01230

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
Although claim 27, as far as concerning a method of treatment, and claim 30 are directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.
2. ☒ Claims Nos.: 13,14  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
1-30(partially)

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

## 1. Claims: 1-30 (partially)

A Chlamydia pneumoniae polynucleotide sequence comprising the nucleic acid sequence of SEQ ID NO:1, a polynucleotide containing at least 38 consecutive nucleotides from SEQ ID NO:1, a polypeptide consisting of the sequence of SEQ ID NO:14 and any polypeptide which is at least 75% identical to said polypeptide sequence; a nucleic acid molecule whose sequence is the antisense of said polynucleotide; fusion protein of said polypeptide and the nucleic acid encoding said fusion protein; vaccine and pharmaceutical compositions comprising said polynucleotide and polypeptide sequences; an unicellular host transformed with said nucleic acid; nucleic acid primers and probes able to hybridize with the polynucleotide of the invention; a method for the recombinant production of said polypeptide; a method for the treatment, prevention, or detection of a Chlamydia infection by using the polynucleotide or the polypeptide of the invention and a kit containing said molecules; a method for the identification of a polypeptide which induces an immune response in a mammal.

## 2. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:2 and the polypeptide of SEQ ID NO:15.

## 3. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:3 and the polypeptide of SEQ ID NO:16.

## 4. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:4 and the polypeptide of SEQ ID NO:17.

## 5. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:5 and the polypeptide of SEQ ID NO:18.

## 6. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:6 and the polypeptide of SEQ ID NO:19.

## 7. Claims: 1-30 (partially)

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

As subject 1 but comprising the polynucleotide of SEQ ID NO:7 and the polypeptide of SEQ ID NO:20.

**8. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:8 and the polypeptide of SEQ ID NO:21.

**9. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:9 and the polypeptide of SEQ ID NO:22.

**10. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:10 and the polypeptide of SEQ ID NO:23.

**11. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:11 and the polypeptide of SEQ ID NO:24.

**12. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:12 and the polypeptide of SEQ ID NO:25.

**13. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:13 and the polypeptide of SEQ ID NO:26.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 13,14

Present claims 13 and 14 relate to an extremely large number of possible compounds, namely, nucleic acid probes that hybridize under stringent conditions to any one of the nucleic acids of the invention, or to a homolog or complementary or anti-sense sequence of said nucleic acids. Support within the meaning of Article 6 PCT and/or disclosure within the meaning of Article 5 PCT is to not be found, however, for none of the compounds. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Consequently, the search has not been carried out for those claims.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP95/01896

## A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl<sup>6</sup> C07K14/295, C12N15/31, C12N1/21, C12P21/02, C12P21/08, C12Q1/68, G01N33/569

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl<sup>6</sup> C07K14/295, C12N15/31, C12N1/21, C12P21/02, C12P21/08, C12Q1/68, G01N33/569

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CAS ONLINE, WPI, WPI/L, BIOSIS PREVIEWS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KIKUTA L. C. et al., "Isolation and Sequence Analysis of the Chlamydia pneumoniae GroE Operon" INFECTION AND IMMUNITY, Dec. 1991, Vol. 59, No. 12, pages 4665-4669	1 - 15, 19 - 30
A	KORNAK J. M. et al., "Sequence Analysis of the Gene Encoding the Chlamydia pneumoniae DnaK Protein Homolog" INFECTION AND IMMUNITY, Feb. 1991, Vol. 59, No. 2, pages 721-725	1 - 14, 19 - 29
A	MELGOSA M. P. et al., "Sequence Analysis of the Major Outer membrane Protein Gene of Chlamydia pneumoniae" INFECTION AND IMMUNITY, Jun. 1991, Vol. 59, No. 6, pages 2195-2199	1 - 14, 19 - 29
A	JP, 4-297871, A (Hitachi Chemical Co., Ltd.), October 21, 1992 (21. 10. 92) & EP, 456524, A1 & US, 5318892, A	16 - 18, 31 - 33
A	JP, 5-317097, A (Fuso Pharmaceutical Co., Ltd.),	34 - 45



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

December 8, 1995 (08. 12. 95)

Date of mailing of the international search report

December 26, 1995 (26. 12. 95)

Name and mailing address of the ISA/

Japanese Patent Office

Facsimile No.

Authorized officer

Telephone No.

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>77813-5</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/CA 99/ 01230</b>	International filing date (day/month/year) <b>23/12/1999</b>	(Earliest) Priority Date (day/month/year) <b>23/12/1998</b>
Applicant <b>CONNAUGHT LABORATORIES LIMITED et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 8 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1 (b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☒ contained in the international application in written form.

☒ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

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☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

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2. ☒ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☐ None of the figures.

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CA 99/01230

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
  
Although claim 27, as far as concerning a method of treatment, and claim 30 are directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.
2. ☒ Claims Nos.: 13,14  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
  
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
  
1-30(partially)

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

## 1. Claims: 1-30 (partially)

A Chlamydia pneumoniae polynucleotide sequence comprising the nucleic acid sequence of SEQ ID NO:1, a polynucleotide containing at least 38 consecutive nucleotides from SEQ ID NO:1, a polypeptide consisting of the sequence of SEQ ID NO:14 and any polypeptide which is at least 75% identical to said polypeptide sequence; a nucleic acid molecule whose sequence is the antisense of said polynucleotide; fusion protein of said polypeptide and the nucleic acid encoding said fusion protein; vaccine and pharmaceutical compositions comprising said polynucleotide and polypeptide sequences; an unicellular host transformed with said nucleic acid; nucleic acid primers and probes able to hybridize with the polynucleotide of the invention; a method for the recombinant production of said polypeptide; a method for the treatment, prevention, or detection of a Chlamydia infection by using the polynucleotide or the polypeptide of the invention and a kit containing said molecules; a method for the identification of a polypeptide which induces an immune response in a mammal.

## 2. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:2 and the polypeptide of SEQ ID NO:15.

## 3. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:3 and the polypeptide of SEQ ID NO:16.

## 4. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:4 and the polypeptide of SEQ ID NO:17.

## 5. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:5 and the polypeptide of SEQ ID NO:18.

## 6. Claims: 1-30 (partially)

As subject 1 but comprising the polynucleotide of SEQ ID NO:6 and the polypeptide of SEQ ID NO:19.

## 7. Claims: 1-30 (partially)

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

As subject 1 but comprising the polynucleotide of SEQ ID NO:7 and the polypeptide of SEQ ID NO:20.

**8. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:8 and the polypeptide of SEQ ID NO:21.

**9. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:9 and the polypeptide of SEQ ID NO:22.

**10. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:10 and the polypeptide of SEQ ID NO:23.

**11. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:11 and the polypeptide of SEQ ID NO:24.

**12. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:12 and the polypeptide of SEQ ID NO:25.

**13. Claims: 1-30 (partially)**

As subject 1 but comprising the polynucleotide of SEQ ID NO:13 and the polypeptide of SEQ ID NO:26.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 13,14

Present claims 13 and 14 relate to an extremely large number of possible compounds, namely, nucleic acid probes that hybridize under stringent conditions to any one of the nucleic acids of the invention, or to a homolog or complementary or anti-sense sequence of said nucleic acids. Support within the meaning of Article 6 PCT and/or disclosure within the meaning of Article 5 PCT is to not be found, however, for none of the compounds. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Consequently, the search has not been carried out for those claims.

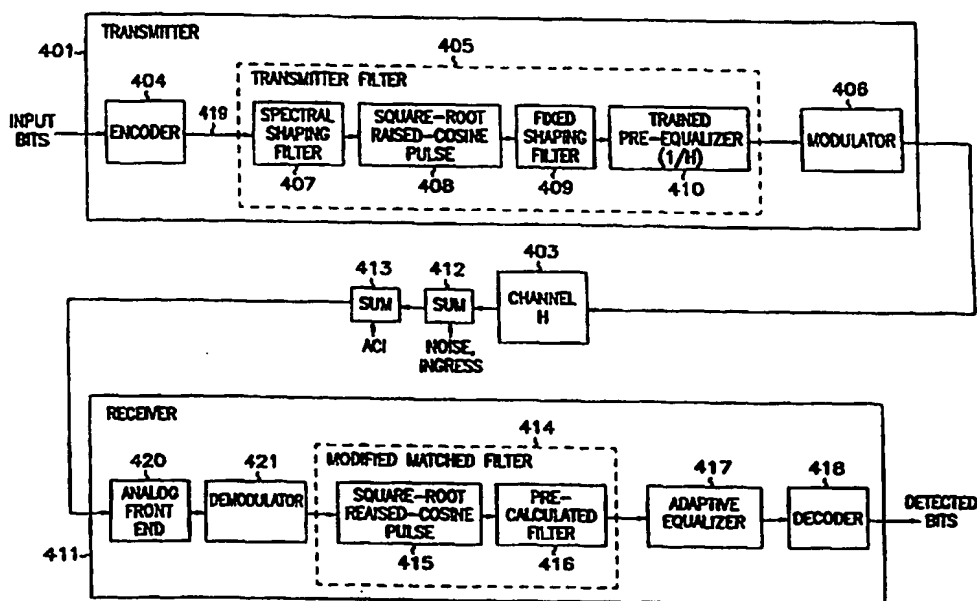
The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: METHOD AND APPARATUS FOR CAPACITY INCREASE AND ENHANCED COMMUNICATIONS PERFORMANCE IN CATV NETWORKS



## (57) Abstract

In a cable television (CATV) data communication network, channel throughput and communications robustness are increased in a manner that improves speed of data transmission while maintaining compatibility with existing specifications and equipment. Enhanced throughput can be realized using the return channel of the CATV network. Alternatively, data retransmission and/or diversity techniques can be used to improve throughput.

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**Method and Apparatus for Capacity Increase and Enhanced  
Communications Performance in CATV Networks**

Related Applications

5           This application claims the benefit of U.S. Provisional Applications Serial  
Numbers 60/083,934 and 60/083,952, both of which were filed on May 1, 1998 under  
35 U.S.C. § 119(c).

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Technical Field

20           The present invention relates generally to communication methods and systems  
and in particular to communication methods and systems implemented using CATV  
(Cable Television) systems.

Background of the Invention

25           Cable television (CATV) systems were originally intended to deliver analog  
television signals to homes in an essentially unidirectional manner. However, the  
coaxial cable used to carry these signals can support bidirectional transmission of  
signals, *i.e.*, transmission both to and from the home. As a result, cable television  
companies have begun to provide data communications services to meet consumers'

growing demand for high speed data transmission over computer networks, such as the Internet.

5 Devices known as cable modems have been developed to convert digital data to a modulated radio frequency (RF) signal, and vice versa, for transmission on a CATV system. This conversion is performed both by a cable modem at the subscriber's home and, on the other end, by headend equipment handling multiple subscribers. Thus, the subscriber receives data from a computer network using a downstream channel and transmits data to the network using an upstream channel.

10 As computer networks deliver increasing amounts of content to users, a need has arisen for increased throughput and communications robustness. It is also essential that communications equipment operate over a wide range of channel impairments, which can include, for example, ingress noise, burst noise, impulse noise, linear distortions, non-linear distortions, and adjacent channel interference. Moreover, the different types of services that use CATV systems give rise to additional needs. For  
15 example, for data services, such as Internet access, a high packet throughput and a low packet error rate are primary considerations. For such applications, low delay is not a key consideration. For multimedia services, such as speech, video, and telephony, however, low delay is the primary consideration. It is desirable to minimize the periods of a high bit error rate (BER) for these applications. Additionally, compatibility with  
20 existing standards and equipment is important for all applications.

#### Summary of the Invention

25 According to one embodiment of the present invention, a transmission arrangement is used for transmitting a data signal using a cable television transmission medium. An encoder encodes an input data stream as an encoder output signal. Adjacent channel interference in this signal is then reduced using a transmission filter arrangement, thereby generating a filter output signal. A modulator modulates the filter output signal to generate a modulated radio frequency signal for transmission using the cable television transmission medium. Another embodiment is directed to a

communication system that, in addition to the above, includes a receiver arrangement that generates a stream of detected data based on the received modulated radio frequency signal.

5 Yet another embodiment of the present invention is directed to an analog front end arrangement for use in the communication system. The analog front end arrangement comprises a plurality of band pass filters coupled to receive a modulated radio frequency signal. Each of the band pass filters is centered around a different frequency. The sample rate is less than the Nyquist rate so as to cause aliasing deliberately. A multiplexer receives output signals from the band pass filters and  
10 couples a selected one of the band pass filter output signals to an output of the multiplexer. An analog to digital converter provides a digital signal, generated as a function of the output of the multiplexer and a clock signal, to a digital receiver. Sample rate logic provides, as a function of the center frequency, a select signal to the multiplexer, a rate parameter to the clock signal generator, and a spectrum inversion  
15 indication to the digital receiver.

Other embodiments are directed to methods for transmitting or communicating a data signal using a cable television transmission medium.

Another aspect of the present invention provides methods and arrangements for robust communications over noisy communications channels using data retransmission  
20 and/or diversity techniques. In one particular embodiment, a communication arrangement includes an encoder that reproduces a symbol or FEC block represented by a segment of an input data stream a predetermined number of times. A transmission arrangement having a plurality of transmission channels transmits each reproduced symbol or FEC block using a distinct transmission channel. A receiver performs soft-  
25 combining of signals received from the outputs of the transmission arrangement.

The present invention can be implemented in full compliance with current network specifications and/or on top of the existing specifications in a manner that enables co-existence of advanced modems designed according to the present invention with current modems.

### Brief Description of the Drawings

In the drawings, in which like reference numbers represent like components throughout the several views,

5 Figure 1 depicts a CATV digital communications system operative according to the Data Over Cable Service Interface Specification (DOCSIS) protocol;

Figure 2 depicts a frequency grid over an upstream channel of a CATV network operative according to the MCNS specification;

10 Figure 3 depicts a reduced channel spacing frequency grid of the upstream channel that can be used in conjunction with the MCNS specification according to an embodiment of the present invention;

Figure 4 depicts a simplified block diagram of a communications apparatus constructed and operative for upstream CATV applications according to an embodiment of present invention;

15 Figure 5 depicts an example of an adaptive equalizer that can be used in conjunction with the embodiment depicted in Figure 4;

Figure 6 depicts an example decoder structure that can be used in conjunction with the embodiment depicted in Figure 4;

Figure 7 depicts an example structure of a modified Reed-Solomon decoder that can be used in conjunction with the embodiment depicted in Figure 4;

20 Figure 8 depicts a structure of an analog front end that can be used in conjunction with the embodiment depicted in Figure 4;

Figure 9 depicts a structure of a modified slicer that can be used in conjunction with the embodiment depicted in Figure 4;

25 Figure 10 depicts a general scheme employing diversity or retransmission techniques, or both, over different MCNS channels;

Figure 11 depicts a signal retransmission technique that can be used in conjunction with the embodiment depicted in Figure 10;

Figures 12A-12B depict two example symbol mapping schemes that can be used in conjunction with the retransmission technique depicted in Figure 11;

Figure 13 depicts an example signal diversity technique that can be used in conjunction with the embodiment depicted in Figure 10; and

Figure 14 depicts a symbol mapping scheme that can be used in conjunction with the signal diversity technique depicted in Figure 13.

5 The invention is amenable to various modifications and alternative forms. Specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

### **Detailed Description**

15 The present invention is applicable to a variety of communications networks operating over a cable television (CATV) infrastructure. An appreciation of various aspects of the invention can be gained through a discussion of various application examples operating in such an environment.

20 According to one example embodiment of the present invention, channel throughput and communications robustness are increased in the upstream or return channel of a CATV network. A filter arrangement is used to reduce interference between adjacent frequency channels, facilitating the use of a frequency grid characterized by reduced channel spacing.

25 Referring now to the drawings, Figure 1 depicts a CATV digital communication system embodying the present invention and operating according to the MCNS specification. For additional information regarding this specification, reference is made to Data-Over-Cable Interface Specifications: Radio Frequency Interface Specification SP-RF1101-970321, published by MCNS Holdings, L.P. on March 21, 1997 (hereinafter referred to as the MCNS specification). The system includes one or more cable modems (CMs) 101a, 101b and a CATV transmission medium 102. It should be noted that, while Figure 1 depicts two CMs, a greater or lesser number of CMs can be

present in the system. A cable modem terminating system (CMTS) 103, which is part of CATV head-end equipment 104, is present at the other side of the network.

Information is transmitted from the CMTS 103 to the CMs 101 using a downstream channel 105, and from the CMs 101 to the CMTS 103 using an upstream channel 106.

5       The CMs 101a, 101b include upstream transmitters 107a, 107b that receive input data 108a, 108b and transmit the input data 108a, 108b using a Quadrature Phase Shift Keying/Quadrature Amplitude Modulation (QPSK/16QAM) modulation scheme with a configurable transmission pulse, pre-equalizer parameters, power level, carrier frequency, symbol clock, and Reed-Solomon forward error correction (FEC) code  
10       parameters. Transmission is performed in a burst mode frequency/time division multiplexing access (FDMA/TDMA) scheme in which each CM 101 transmits requests for bandwidth allocation, and in which a channel allocator 109 sends control messages to the CMs 101 via the downstream channel 105, indicating the time period in which the addressed CM 101 can transmit. The CM 101 is capable of modifying its signal  
15       parameters, including transmission power, carrier frequency, transmission pulse, and pre-equalizer parameters, according to these control messages from the channel allocator 109.

      The CMTS 103 includes a receiver 110 and the channel allocator 109. The receiver 110 detects the information bits fed into the inputs 108a, 108b of the upstream  
20       transmitters 107a, 107b. The receiver 110 then estimates the parameters of the received signals, and outputs these parameters to the channel allocator 109. The channel allocator 109 then allocates frequency ranges and configures transmission parameters for the individual CMs 101 in a manner that will make efficient use of the channel bandwidth and that will enable the receiver to detect the signals properly.

25       Figure 2 depicts a frequency constellation of a CATV network operative according to the MCNS specification. Signals 201a-201c have the same nominal symbol rate, while signal 201d has a larger symbol rate, and signal 201e has a lower symbol rate. The nominal bandwidth of each signal 201a-201e is 1.25 times its respective symbol rate.

Figure 3 depicts an example of a reduced channel spacing frequency grid with which the present invention can be used. The channel spacing is less than the signal bandwidth, which is 1.25 times the symbol rate of the signals. Such a system uses overlapped transmission scheme, such as that disclosed in U.S. Patent 5,710,797, issued on January 20, 1998, assigned to the instant assignee, and entitled METHOD AND APPARATUS FOR DIGITAL COMMUNICATION IN THE PRESENCE OF CLOSELY SPACED ADJACENT CHANNELS, the disclosure of which is hereby incorporated by reference in its entirety.

Referring now to Figure 4, a simplified block diagram is depicted of a communications apparatus constructed and operative for upstream CATV applications according to a particular embodiment of the present invention. The apparatus of Figure 4 includes a transmitter 401 that transmits a digital communication signal 402 through an upstream channel 403. The transmitter 401 comprises an encoder 404, a transmission filter 405, and a modulator 406. The transmission filter 405 comprises a cascade of a spectral shaping filter 407, a square-root raised cosine filter 408, a fixed shaping filter 409, and a trained pre-equalizer 410. This transmission structure may be supported by the current MCNS specification, and therefore may be supported by current MCNS implementations.

The encoder 404 can include any Forward Error Correction (FEC) code, such as Reed-Solomon encoding. The encoder 404 optionally uses an interleaver within the packet in order to counteract impulse/burst noise. Using an interleaver in this manner, however, involves modifications that may not be consistent with existing DOCSIS specifications. Alternate signal constellations can be used instead of those specified in the MCNS specification. Examples of such alternate signal constellations include, but are not limited to,  $\pi/4$ -QPSK, offset-QPSK, 8PSK, 32QAM, 64QAM, 128QAM, and 256QAM. The choice of a particular signal constellation is dependent on channel conditions. Tomlinson precoding can also be used to avoid a DFE at the receiver 411, but this technique also involves modifications that may not be consistent with existing DOCSIS specifications.

According to a particular implementation, the spectral shaping filter 407 comprises a duo-path filter  $(1+\alpha z^{-N})$ , where  $\alpha$  can be a complex number) or any other pre-equalizer that can be used to achieve an approximation to the water-pouring spectral density in conjunction with a DFE receiver, e.g.  $(1+e^{-j\omega_0}z^{-1})$  for elimination of narrow-band interference at  $\omega_0$ . The purpose of the shaping filters 407, 408, and 409 is to  
5 reduce adjacent channel interference (ACI) to facilitate the use of a frequency grid characterized by reduced channel spacing.

The fixed shaping filter 409 is designed for a more or less known level of signal-to-noise (SNR) ratio and Signal-to-Interference (C/I) ratio, and may be loaded  
10 during ranging when the C/I and SNR are assessed. The trained pre-equalizer 410 performs essentially the inverse  $1/H$  of the transfer function  $H$  of the upstream channel 403 and is trained at the receiver 411, where the parameters describing the upstream channel 403 are transmitted to the CM 101 through a downstream channel 105 of Figure 1.

15 The transmitted signal 402 is impaired by the linear distortion  $H$  of the upstream channel 403, by non-linear distortions, and by additive noise sources, including ingress noise and adjacent channel interference. The effects of ingress noise and adjacent channel interference are conceptually illustrated in Figure 4 as summing blocks 412 and 413, respectively.

20 The receiver 411 includes an analog front end 420, a demodulator 421, and a modified matched filter (MMF) 414, which performs a convolution of a square-root raised cosine filter 415 and a pre-calculated filter 416 working at  $N$  times the symbol rate (e.g.,  $N=2$ ). The MMF filter 414 can be loaded from a table according to the estimated C/I and SNR. It should be noted that the pre-calculated filter 416 can be  
25 jointly designed with the transmission filter 405 to improve the overall SNR and C/I at the receiver 411. The output of the MMF 414 is provided to an adaptive equalizer 417, followed by a decoder 418, which may include additional filtering, a Viterbi detector, and a FEC decoder.



The MMF 414 can be designed to have low side lobes in the time domain. This is a deviation from an ideal square-root raised-cosine pulse. This deviation might be compensated for by the pre-equalizer 410. The reduction in side lobes in the time domain can also prevent the propagation of an impulse noise to symbols that were not originally hit by the impulse.

Figure 8 depicts an example implementation of an analog front end 420. This implementation includes a filter bank 801 of band pass filters (BPFs) 801a, 801b, . . . , 801n. Each BPF 801 is centered around a different frequency. The output of the BPFs 801, denoted in Figure 8 with reference numerals 804a, 804b, . . . , 804n, is input into an analog multiplexer 802. Sample rate logic 815 generates a select signal 803 as a function of the center frequency. The select signal 803 selects which of the BPF outputs 804 is coupled to an output 805 of the multiplexer 802.

A parameter  $F_s$ , also generated by the sample rate logic 815 as a function of the center frequency and denoted with reference numeral 806, defines the sample rate of an analog to digital converter (ADC) 809 and is provided by a clock generator 810. In this embodiment, the sample rate can be smaller than the Nyquist rate and can be chosen such that deliberate aliasing will shift the center frequency of the desired signal from its original frequency  $F_{co}$ , which can be greater than  $F_s/2$ , to a new frequency  $F_{cb}$ , such that  $F_{cb}$  is less than  $F_s/2$ . Thus, deliberate aliasing facilitates the use of discrete ADC components to sample signals having a frequency greater than half the frequency of the ADC. It will be appreciated by those skilled in the art that, when aliasing occurs due to undersampling, the digital receiver 808 should compensate for it. Accordingly, the sample rate logic 815 also provides a spectrum inversion indication 820 to the digital receiver 808 to indicate that undersampling has occurred.

An example of an adaptive equalizer is depicted in Figure 5. The adaptive equalizer of Figure 5 is an adaptive Decision Feedback Equalizer (DFE) operating in a noise prediction configuration 501, and it may be preceded by an adaptive FSE 502. By using the adaptive FSE 502, the magnitude of the DFE taps can be reduced using tap leakage procedures, thus reducing DFE error propagation. To avoid any error

propagation at all, the adaptive FSE only can be used, completely avoiding the DFE. The equalizer taps are modified by a Linear Mean Square (LMS) approach. It can be trained during the ranging phase of the CMTS and/or pre-loaded using prior knowledge of channel spacing, and perhaps C/I and SNR.

5        Figure 6 depicts the structure of the decoder when a duo-path pulse  $1+\alpha z^{-N}$ , where  $\alpha$  can be a complex number, is used. An equalizer 601 is adjusted to achieve a sum of two symbols at its output. The output of the equalizer passes through a  $1+\alpha z^{-N}$  filter 602, and then goes to a Viterbi detector 603. For example, if the encoder output 419 in Figure 4 is QPSK symbols  $\pm I \pm jQ$ , then the modified slicer 604 of the DFE searches for constellation points  $I+jQ$ , where I and Q can have values of 2, 0, and -2. The  
10        adaptive DFE 605 is trained to minimize the error between the slicer input and the slicer output.

      The complexity of the Viterbi is 4 states and 16 branches per QPSK symbol and 16 states and 256 branches in 16QAM. As an alternative, a reduced 16QAM version of  
15        4 states and 16 branches per symbol can be used.

      It should be noted that, instead of a DFE, advance equalization techniques such as a maximum likelihood sequence estimator (MLSE) can be used. The idea here is to implement noise prediction and compensation of deliberate ISI due to transmission pulse using a reduced Viterbi equalizer.

20        The FEC decoder 606 can be implemented using a conventional Reed-Solomon decoder, assuming this is the code being used in the system. Alternatively, one can use the configuration depicted in Figure 7, where the burst noise identifier 701 identifies an exceptional data point based on inputs from an Analog Front End (AFE) 702 and a QPSK/16QAM receiver 703 and analyzes the presence and the length of noise burst.

25        The Reed-Solomon decoder 704 uses erasures for the data bytes that are suspected to be affected by noise.

      The exceptional data points are detected by either saturations or very large values of the data at the signal path (e.g., at the slicer input), a sequence of large error values at the slicer, or yielding of different symbol decisions for the two signals in

retransmission mode. The receiver has a state machine that estimates burst duration according to the indication of exceptional data points and puts the Reed-Solomon decoder in an erasure mode during the burst. In addition, the receiver performs clipping of signals with exceptionally large magnitudes.

5           The present invention can be used in conjunction with reduced spaced signal constellations, such as that depicted in Figure 3, by following the procedures described in U.S. Patent 5,710,797. In particular, the algorithm may iterate as follows. For a set of overlapping signals, the previously processed signal is subtracted from the received signal. A signal is then detected using the receiver 410 and is remodulated. The  
10       algorithm should start with the signal having the best C/I and SNR, which is typically the strongest signal, or a signal that has only one overlapping ACI, rather than two.

          Pairs of severely interfering signals may be jointly detected using an encoded joint maximum likelihood approach, as part of the iterations of a method, the general procedure of which is outlined in U.S. Patent 5,710,797. The joint maximum likelihood  
15       procedure involves a Viterbi-like algorithm for which a trellis diagram with a branch metric is defined. The complexity of such an approach, based on a memory constraint of three symbols for each signal, is 16 states and 256 branches per symbol with QSPK and 256 states and 64K branches per symbol in 16QAM. The number of transitions can be significantly reduced using a reduced state Viterbi algorithm, *e.g.*, by discarding  
20       states in the trellis diagram that are unlikely for the current signal sample. The algorithm then selects a survivor path for each of the remaining new states based on the cumulative metric for all possible paths entering the new state from the previous states, followed by the selection of the leading path, and detection of the information bits. The algorithm then discards unlikely new states based on the cumulative metrics.

25           The present invention can also be used in conjunction with a frequency hopping scheme, using joint frequency/time axis forward error correction and interleaving.

          As part of the signal acquisition stage, in which the received signal parameters are estimated, the receiver 411 makes use of a preamble field in a data packet. In the presence of impulse and burst noise, the preamble should be longer than the duration of

the longest error burst that can be recovered by the receiver (*i.e.*, at least  $2t$  bytes if Reed-Solomon block code  $(N-t, N)$  is used, where  $N$  is the block size. The preamble is split into sections, and the receiver identifies sections that are noisy, for example, according to the residual error between the incoming signal and the expected signal according to the known training data and estimated parameters. Sections that are noisy due to impulse or burst noise are neglected.

In case the receiver is capable of recovering a very long error burst, in particular, if interleaving is used, then the packet structure PDDDPDDDD...D may be used, where P is a preamble section and D is a data section. The distance between P sections will be larger than the maximum burst length that can be received.

Acquisition performance can be severely affected by narrow-band interference, such as ingress noise, *e.g.*, narrowband interference, or partially overlapping channels. Thus, it is particularly advantageous to use a preamble that has low spectral density at frequency regions of high noise and high spectral density at frequency regions of low noise. This can be achieved using a pre-equalizer in the transmitter, or by using a non-white sequence of symbols. As a result, the interference of the transmitted preamble into overlapping adjacent channels will be reduced, enabling robust acquisition of overlapping signals.

Figure 9 depicts a modified slicer structure that can be used in connection with the communication apparatus of Figure 4. In this modified slicer structure, a slicer 901 produces an estimate 902 of the original transmitted symbol 419 of Figure 4. This estimate is filtered by a digital filter whose response is  $\alpha Z^{-n}$ , that is, delayed by  $n$  taps and multiplied by  $\alpha$ , where  $\alpha$  can be a complex number. An output 909 of the filter 905 is subtracted from the next input sample 902 by a subtractor 903 to generate a slicer input 906. The output 909 is also summed with a slicer output 907 by a summer 904 to generate a modified slicer output 908. In receivers where an error estimate is needed for adaptation, such an estimate can be calculated by subtracting the slicer output 907 from the slicer input 906 or by subtracting the modified slicer output 908 from the

estimate 902. The latter calculation method realizes improved robustness for error propagation.

According to another embodiment of the present invention, channel throughput and communications robustness are increased using re-transmission techniques and/or diversity techniques. These techniques are particularly useful when the receiver is incapable of detecting the transmitted data from a single transmission. There are different MCNS channels, *e.g.*, different time slots or different carrier frequencies.

Figure 10 depicts a general scheme that utilizes diversity and/or retransmission techniques over different MCNS channels according to this embodiment of the present invention. A 1:N rate encoder 1001 reproduces the current symbol or the current FEC block N times. Each reproduced symbol or block is transmitted using N MCNS signals 1002 to be communicated to the CMTS 103 of Figure 1 over N different channels 1003. It will be appreciated that the N channels represent physical (*e.g.*, different carriers) and/or logical channels and can overlap in frequency. Outputs 1004 of the N channels are provided to a receiver 1005, which performs weighted soft-combining of the received signals 1004. The soft-combining comprises Mean Squared Error (MSE) estimation as well as identification of burst noise within the packet, followed by weighted or selective combining, as appropriate. The receiver can also incorporate joint equalization of the received signals.

The system in Figure 10 can also be interpreted as a retransmission technique in which the first MCNS signal transmitted over the first channel is the original message and all subsequent messages are requested by the CMTS 103 of Figure 1 one, or several, at a time to be retransmitted. According to a specific embodiment, a soft-combining method is applied to all the received messages.

For example, a retransmission request, possibly at a different carrier, can be sent from the CMTS 103 to the CM 101 of Figure 1 via the downstream channel 105 only if a Reed-Solomon block is received incorrectly. If a Reed-Solomon block is received incorrectly, then instead of requesting retransmission, the CMTS 103 tells the CM 101 what it received, so that the CM 101 can send to the CMTS 103 a short correction

message rather than sending the whole packet again. For example, the CMTS 103 may send back to the CM 101 an indication of the quality level of the detected symbols or the detected symbols themselves. Since the downstream channel 105 is much wider and more reliable than the upstream channel 106, this approach may be preferable.

5           Figure 11 depicts a particular retransmission scheme in which a different mapping for 16QAM is used for the retransmission. Two symbol mapping schemes are illustrated in Figures 12A-12B, in which A1, A2, A3, A4, B1, B2, B3, B4, C1, C2, C3, C4, D1, D2, D3, and D4 represent the sixteen combinations of four bits.

10           Figure 13 depicts a signal diversity system. In this system, two information bits  $[b1(n) \ b2(n)]$ , denoted by reference numeral 1301, per symbol are transmitted. The symbols are 16QAM and are mapped using a signal mapping block 1302 as a function of  $[b1(n) \ b2(n) \ b1(n-D) \ b2(n-D)]$ , where D is a delay introduced by a delay block 1303. Figure 14 depicts an example mapping scheme.

15           Using this approach, bursts of length D symbols can be recovered. In this approach, the carrier frequency may change between two transmissions of the same data. This change in carrier frequency can be used to protect from narrow band interference.

### **Conclusion**

20           Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement which is calculated to achieve the same purpose may be substituted for the specific embodiments shown. Many adaptations of the invention will be apparent to those of ordinary skill in the art. Accordingly, this application is intended to cover any adaptations or variations  
25           of the invention. It is manifestly intended that this invention be limited only by the following claims and equivalents thereof.

**What is claimed is:**

1. A transmission arrangement for transmitting a data signal using a cable television transmission medium, the transmission arrangement comprising:  
an encoder configured to encode an input data stream as an encoder output signal;  
a transmission filter arrangement, responsive to the encoder output signal and configured to reduce adjacent channel interference in the encoder output signal and to generate a filter output signal; and  
a modulator, configured to modulate the filter output signal, generating a modulated radio frequency signal for transmission using the cable television transmission medium.
2. A transmission arrangement, according to claim 1, wherein the encoder is configured to encode the input data stream using a forward error correction code.
3. A transmission arrangement, according to claim 2, wherein the forward error correction code is a Reed-Solomon encoding scheme.
4. A transmission arrangement, according to claim 1, wherein the encoder comprises an interleaver configured to counteract at least one of impulse noise and burst noise.
5. A transmission arrangement, according to claim 1, wherein the transmission filter arrangement comprises a spectral shaping filter, a square-root raised cosine filter, a fixed shaping filter, and a trained pre-equalizer arranged in a cascaded configuration.

6. A transmission arrangement, according to claim 5, wherein the spectral shaping filter is configured to eliminate the effect of narrow band interference at a selected frequency.
7. A communication system for communicating a data signal using a cable television transmission medium, the communication arrangement comprising:
  - an encoder configured to encode an input data stream as an encoder output signal;
  - a transmission filter arrangement, responsive to the encoder output signal and configured to reduce adjacent channel interference in the encoder output signal and to generate a filter output signal;
  - a modulator, configured to modulate the filter output signal, generating a modulated radio frequency signal for transmission using the cable television transmission medium; and
  - a receiver arrangement coupled to receive the modulated radio frequency signal and configured to generate a stream of detected data based on the received modulated radio frequency signal.
8. A communication system, according to claim 7, wherein the receiver arrangement comprises:
  - an analog front end arrangement, configured to sample a desired signal from the received modulated radio frequency signal at less than the Nyquist rate and to cause thereby a shift in a center frequency of the desired signal from an initial frequency to a lower frequency;
  - a modified matched filter configured to perform a convolution of a square-root raised cosine filter and a pre-calculated filter and to generate a modified matched filter output signal;
  - an adaptive equalizer, responsive to the modified matched filter output signal and configured to generate an equalizer output signal; and



a decoder, responsive to the equalizer output signal and configured to decode the equalizer output signal and to generate the stream of detected data.

9. A communication system, according to claim 8, wherein the analog front end arrangement comprises:

a plurality of band pass filters coupled to receive the modulated signal, each of the band pass filters centered around a different frequency;

a multiplexer coupled to receive output signals from the band pass filters and to couple a selected one of the band pass filter output signals to an output of the multiplexer;

an analog to digital converter, responsive to the output of the multiplexer and to an output of a clock signal generator and configured to provide a digital signal, generated as a function of the output of the multiplexer and the output of the clock signal generator, to a digital receiver.

10. A communication arrangement, according to claim 9, wherein the analog front end arrangement further comprises sample rate logic configured to provide, as a function of the center frequency, a select signal to the multiplexer, a rate parameter to the clock signal generator, and a spectrum inversion indication to the digital receiver.

11. A communication system, according to claim 8, wherein the adaptive equalizer comprises an adaptive decision feedback equalizer.

12. A communication system, according to claim 8, wherein the pre-calculated filter comprises

a pre-equalizer, configured to reduce interference attributable to at least one of ISI and ingress noise associated with a communication channel, and

a  $1+\alpha z^{-N}$  filter, coupled to the output of the pre-equalizer and configured to generate a filter output signal;

and wherein the receiver arrangement comprises  
a Viterbi decoder, configured to generate a Viterbi decoder output signal as a function of the filter output signal; and  
a forward error correction decoder, configured to generate a corrected decoder output signal in response to the Viterbi decoder output signal.

13. A communication system, according to claim 7, further comprising a modified slicer arrangement configured to produce an estimate of an original transmitted symbol.

14. A communication system, according to claim 13, wherein the modified slicer arrangement comprises:

- a slicer configured to estimate an output of the encoder;
- a filter having a response of  $\alpha Z^{-N}$ ;
- a summing arrangement configured to add an output of the slicer to an output of the filter having a response of  $\alpha Z^{-N}$ ;
- a subtracting arrangement configured to subtract the output of the filter having a response of  $\alpha Z^{-N}$  from an input of the modified slicer;
- an error estimation arrangement, coupled to both an input and the output of the slicer and configured to estimate a receiver error; and
- a modified error estimation arrangement, coupled to both an input and the output of the modified slicer and configured to estimate the receiver error.

15. A communication system for communicating a data signal using a cable television transmission medium, the communication arrangement comprising:

- an encoder configured to encode an input data stream as an encoder output signal;
- a transmission filter arrangement, responsive to the encoder output signal and configured to reduce adjacent channel interference in the encoder output signal and to generate a filter output signal;

a modulator, configured to modulate the filter output signal, generating a modulated radio frequency signal for transmission using the cable television transmission medium;

an analog front end arrangement, configured to sample a desired signal from the modulated radio frequency signal at less than the Nyquist rate and thereby to cause a shift in a center frequency of the desired signal from an initial frequency to a lower frequency;

a modified matched filter configured to perform a convolution of a square-root raised cosine filter and a pre-calculated filter and to generate an modified matched filter output signal;

an adaptive equalizer, responsive to the modified matched filter output signal and configured to generate an equalizer output signal; and

a decoder, responsive to the equalizer output signal and configured to decode the equalizer output signal and to generate a stream of detected data.

16. An analog front end arrangement for use in a communication system for communicating a data signal using a cable television transmission medium, comprising:

a plurality of band pass filters coupled to receive a modulated radio frequency signal, each of the band pass filters centered around a different frequency, wherein a sampling rate is less than the Nyquist rate so as to cause aliasing deliberately;

a multiplexer coupled to receive output signals from the band pass filters and to couple a selected one of the band pass filter output signals to an output of the multiplexer;

an analog to digital converter, responsive to the output of the multiplexer and to an output of a clock signal generator and configured to provide a digital signal, generated as a function of the output of the multiplexer and the output of the clock signal generator, to a digital receiver; and

sample rate logic configured to provide, as a function of the center frequency, a select signal to the multiplexer, a rate parameter to the clock signal generator, and a spectrum inversion indication to the digital receiver.

17. A transmission method for transmitting a data signal using a cable television transmission medium, the transmission method comprising:
  - encoding an input data stream as an encoder output signal;
  - filtering the encoder output signal to reduce adjacent channel interference in the encoder output signal, thereby generating a filter output signal; and
  - modulating the filter output signal to generate a modulated radio frequency signal for transmission using the cable television transmission medium.
18. A transmission method, according to claim 17, further comprising encoding the input data stream using a forward error correction code.
19. A transmission method, according to claim 18, wherein the forward error correction code is a Reed-Solomon encoding scheme.
20. A communication method for communicating a data signal using a cable television transmission medium, the communication method comprising:
  - encoding an input data stream as an encoder output signal;
  - filtering the encoder output signal to reduce adjacent channel interference in the encoder output signal, thereby generating a filter output signal;
  - modulating the filter output signal to generate a modulated radio frequency signal for transmission using the cable television transmission medium;
  - receiving the modulated radio frequency signal; and
  - generating a stream of detected data based on the received modulated radio frequency signal.

21. A communication method, according to claim 20, further comprising:  
sampling a desired signal from the received modulated radio frequency signal at less than the Nyquist rate and causing thereby a shift in a center frequency of the desired signal from an initial frequency to a lower frequency;  
performing a convolution of a square-root raised cosine filter and a pre-calculated filter and to generate an modified matched filter output signal;  
generating an equalizer output signal as a function of the modified matched filter output signal; and  
decoding the equalizer output signal to generate the stream of detected data.
22. A communication method, according to claim 21, further comprising:  
providing a select signal to the multiplexer as a function of the center frequency;  
providing a rate parameter as a function of the center frequency; and  
providing a spectrum inversion indication as a function of the center frequency.
23. A communication arrangement for communicating a data signal using a cable television transmission medium, the communication arrangement comprising:  
a 1:N rate encoder, coupled to an input data stream and configured to reproduce a symbol or FEC block represented by a segment of the input data stream N times;  
a transmission arrangement configured to use a plurality of outputs to transmit each reproduced symbol or FEC block using a distinct transmission channel; and  
a receiver, coupled to the outputs of the transmission arrangement and configured to perform soft-combining of signals received from the outputs of the transmission arrangement and to output an estimate of the symbol or FEC block.
24. A communication arrangement, according to claim 23, wherein the soft-combining comprises at least one of mean squared error estimation, identification of burst noise within a data packet, weighted combining, and selective combining.

25. A communication arrangement, according to claim 23, wherein one of the transmission channels is used to transmit an original message and the remaining transmission channels are used to perform retransmission.
26. A communication arrangement, according to claim 23, wherein a plurality of information bits are used to represent a symbol to be transmitted, and wherein the transmission channels are used to transmit the information bits using a delay-encoded mapping scheme.
27. A communication method for communicating a data signal using a cable television transmission medium, the communication method comprising:  
reproducing a symbol or FEC block represented by a segment of an input data stream a preselected number of times;  
using a plurality of transmission channels to transmit each reproduced symbol or FEC block using a distinct transmission channel; and  
performing soft-combining of signals received from the transmission channels.
28. A communication method, according to claim 27, wherein the soft-combining comprises at least one of mean squared error estimation, identification of burst noise within a data packet, weighted combining, and selective combining.
29. A communication method, according to claim 27, further comprising:  
transmitting an original message using one of the transmission channels; and  
performing retransmission using the remaining transmission channels.
30. A communication method, according to claim 27, further comprising:  
using a plurality of information bits to represent a symbol to be transmitted; and  
using the transmission channels to transmit the information bits using a delay-encoded mapping scheme.

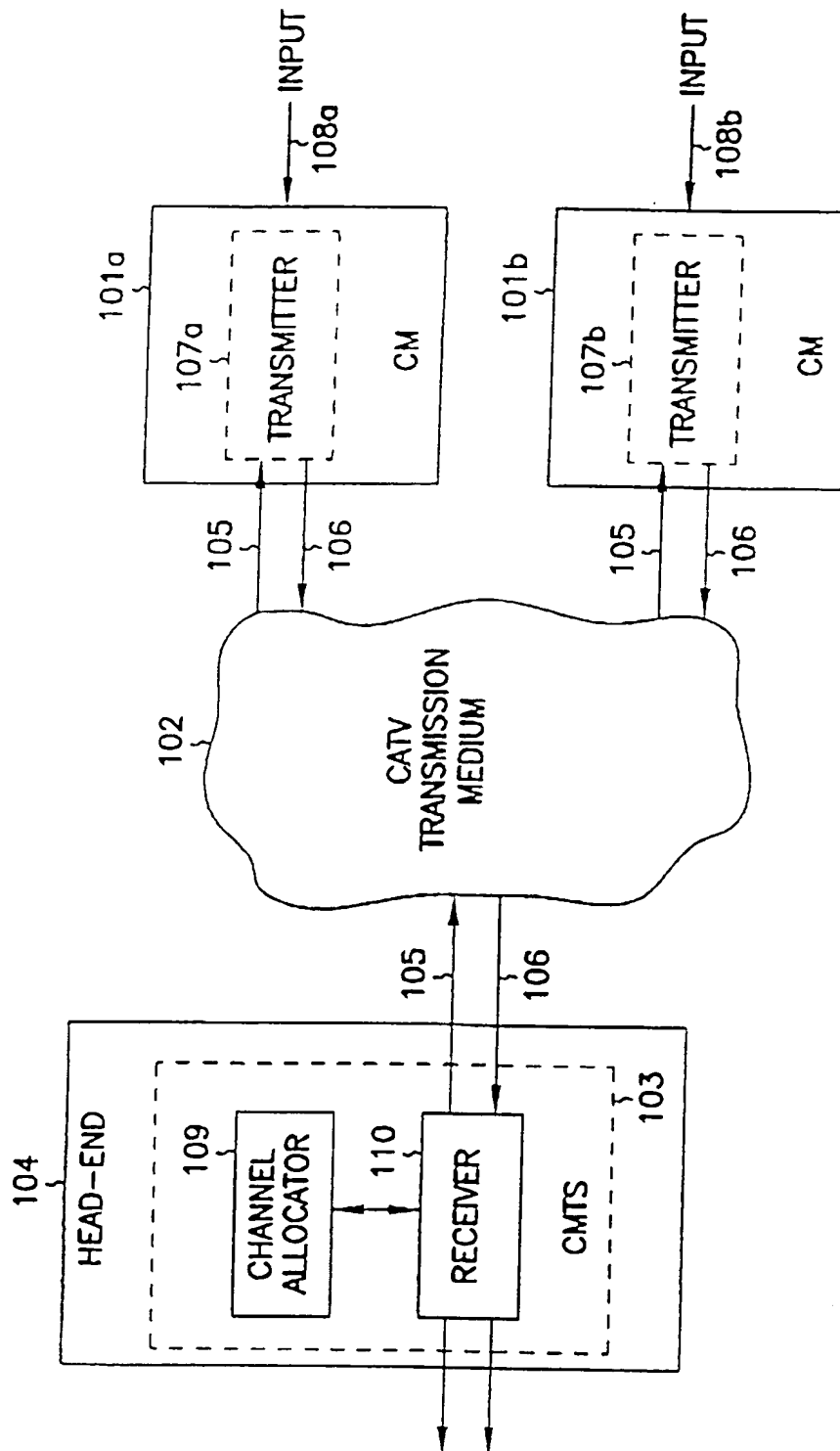


FIG. 1

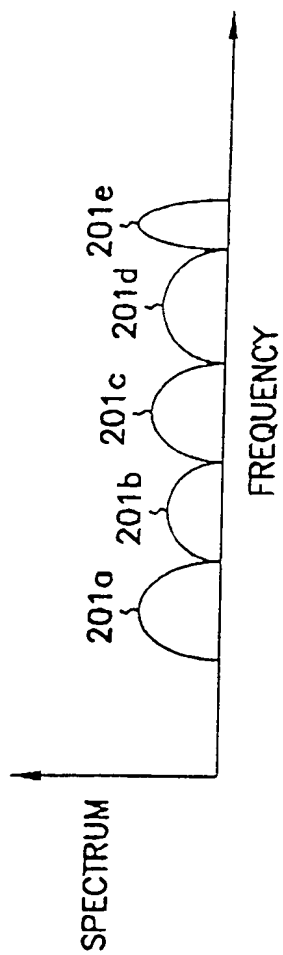


FIG. 2

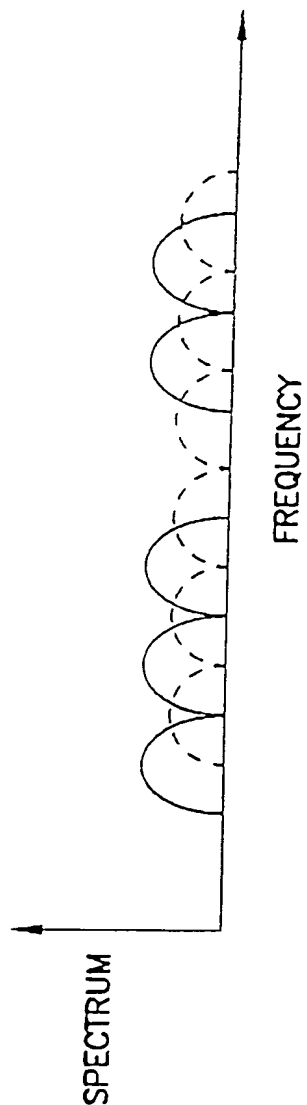


FIG. 3



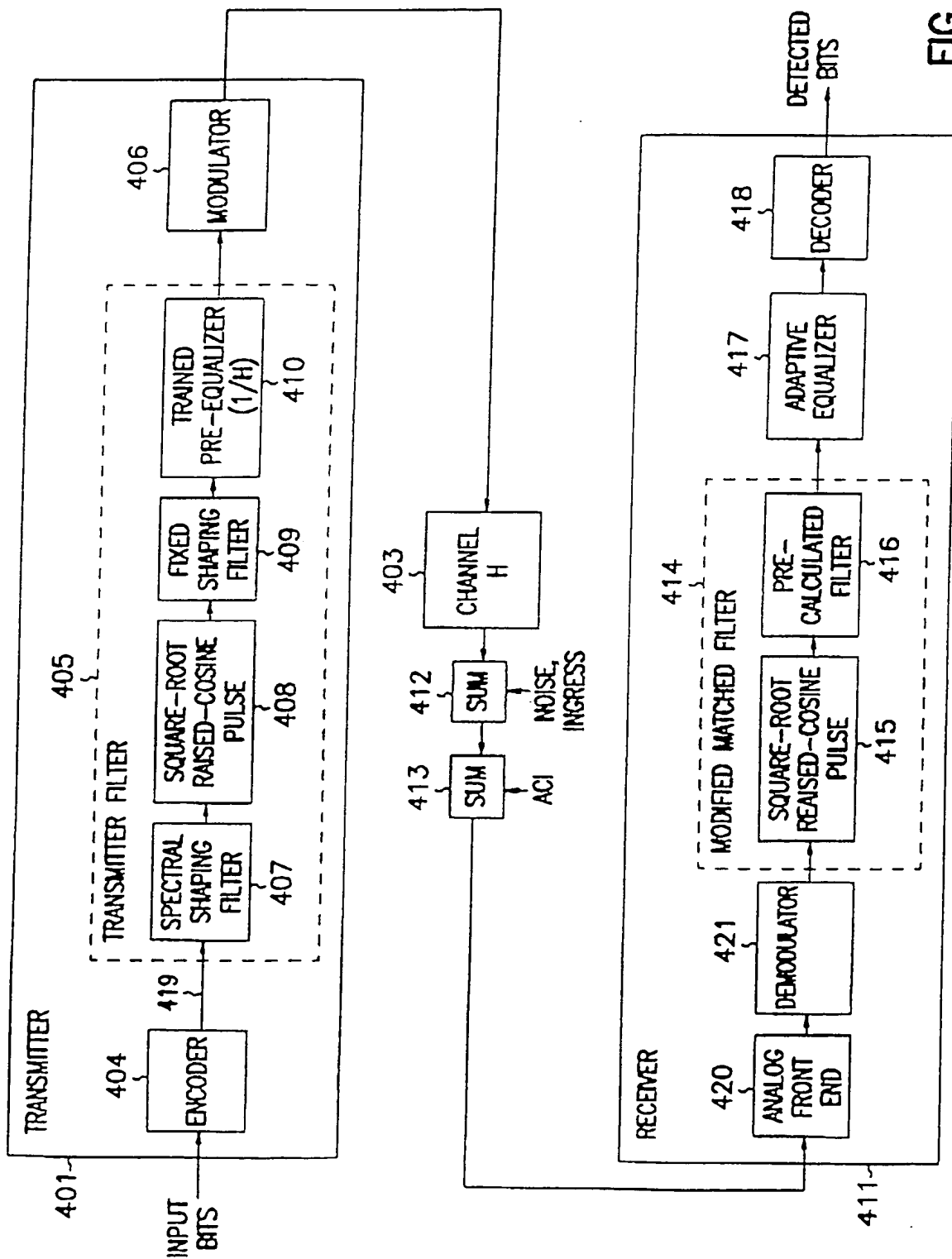


FIG. 4

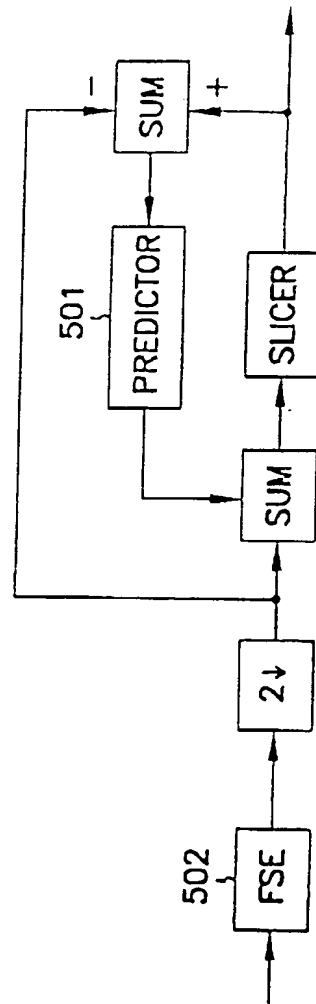


FIG. 5

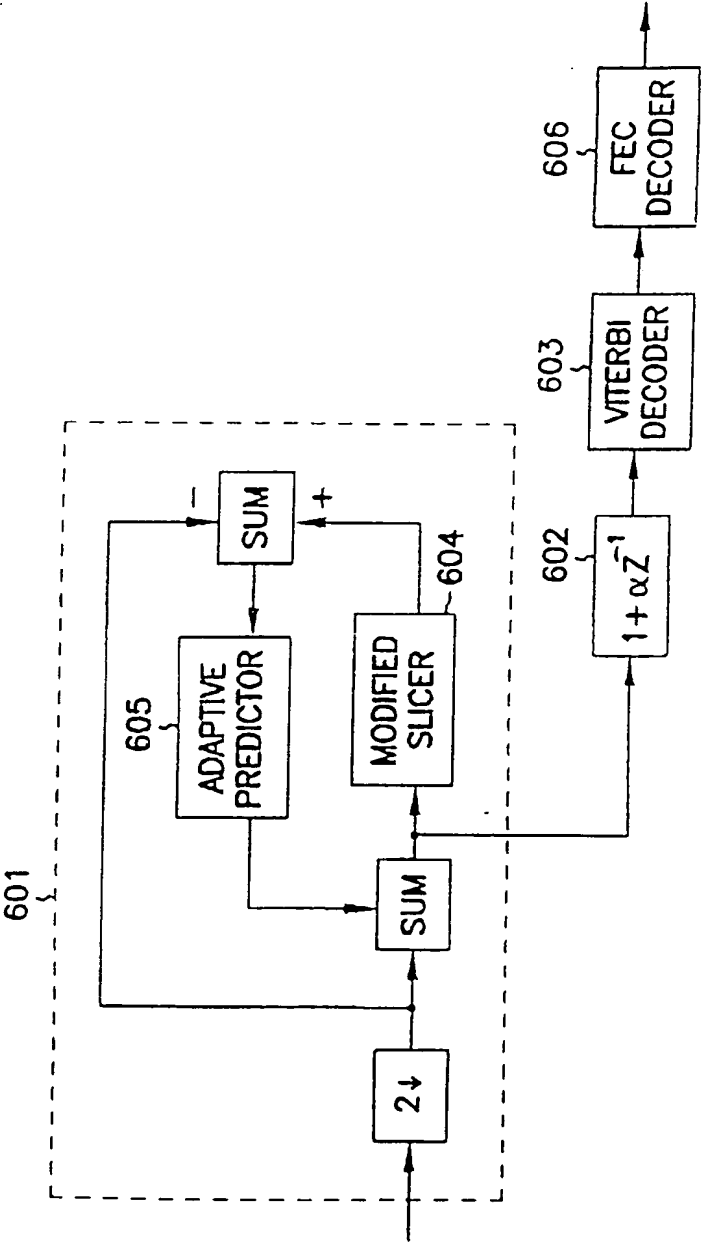


FIG. 6

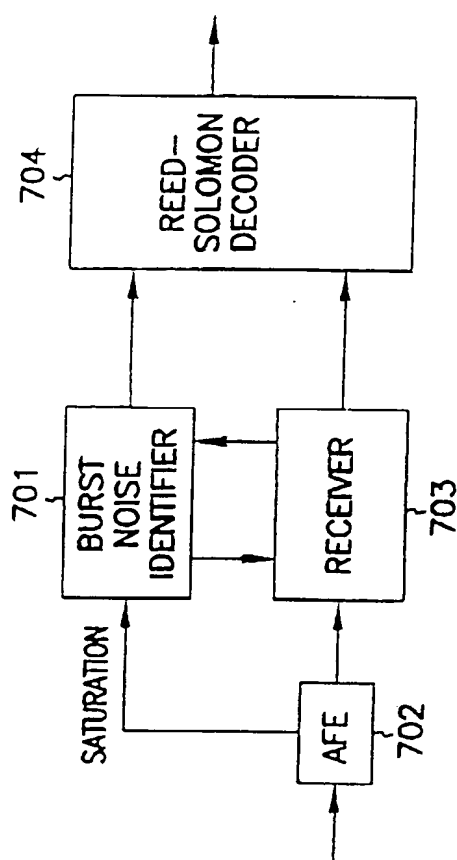
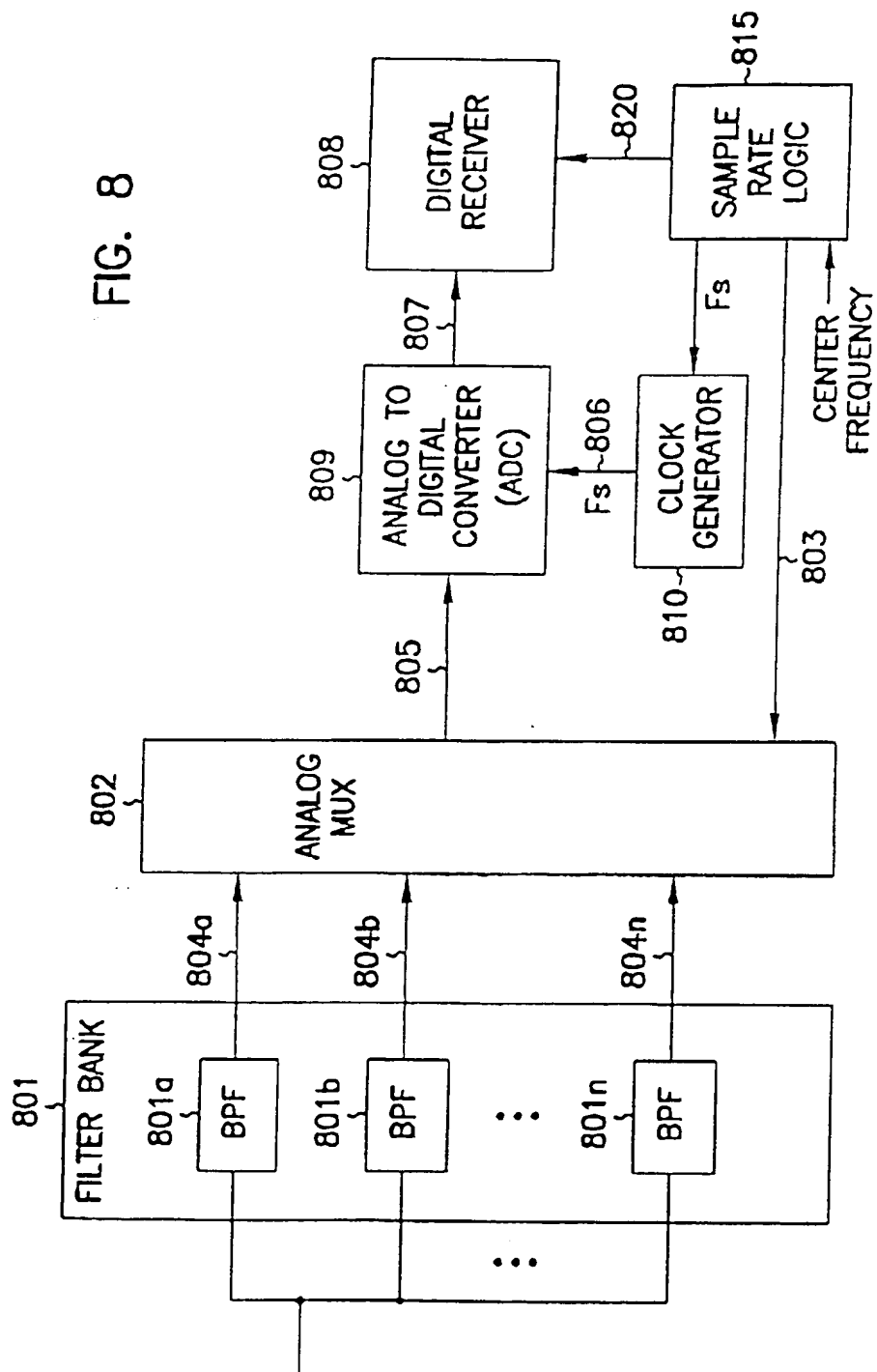


FIG. 7

FIG. 8



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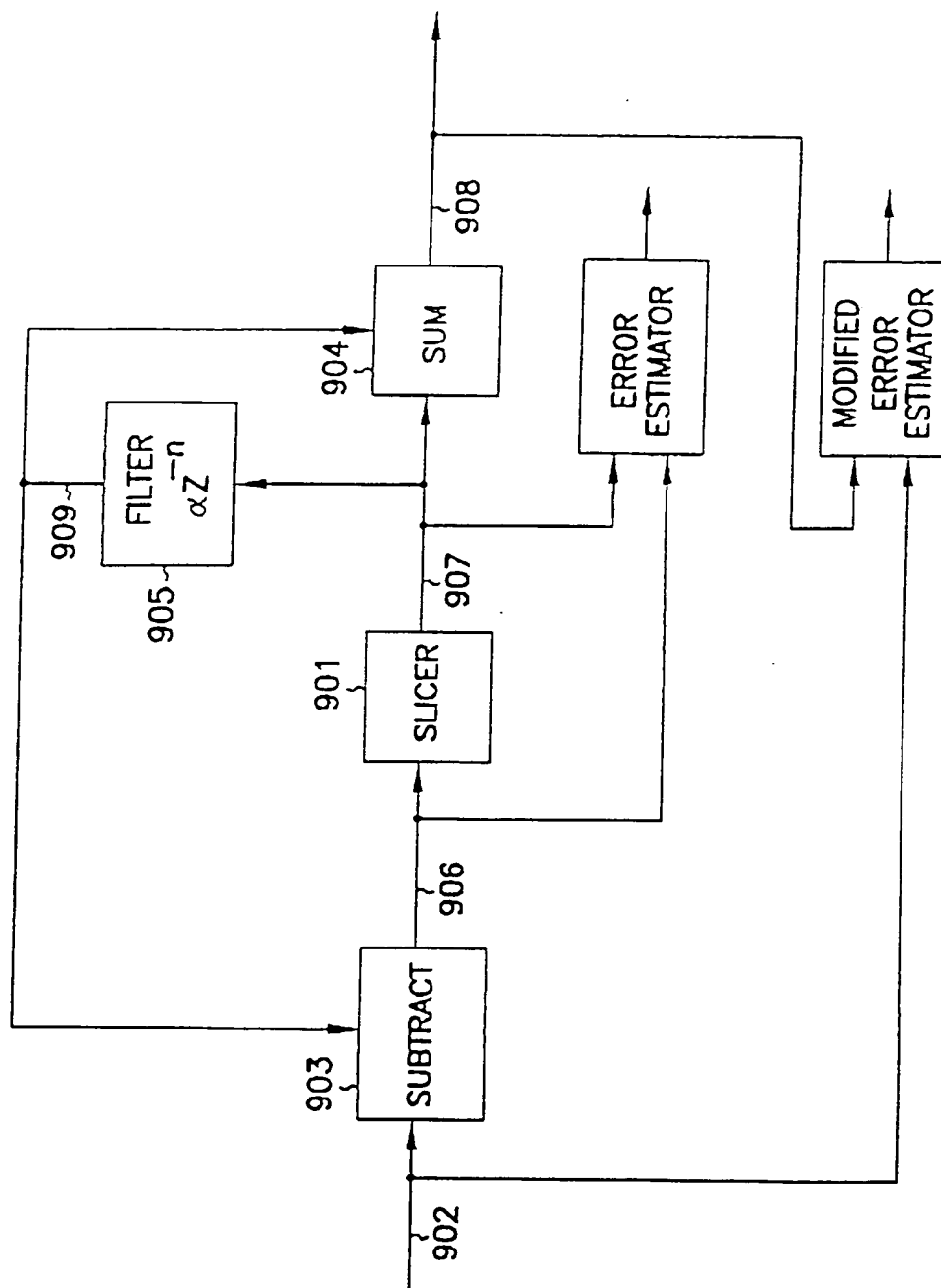


FIG. 9

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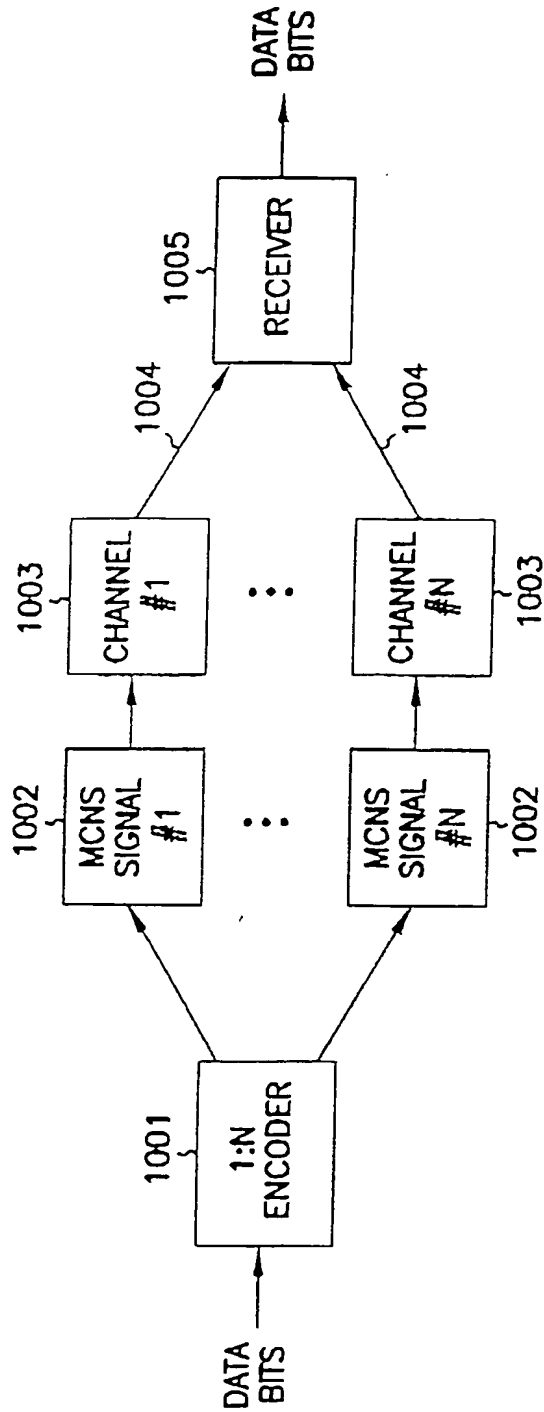


FIG. 10

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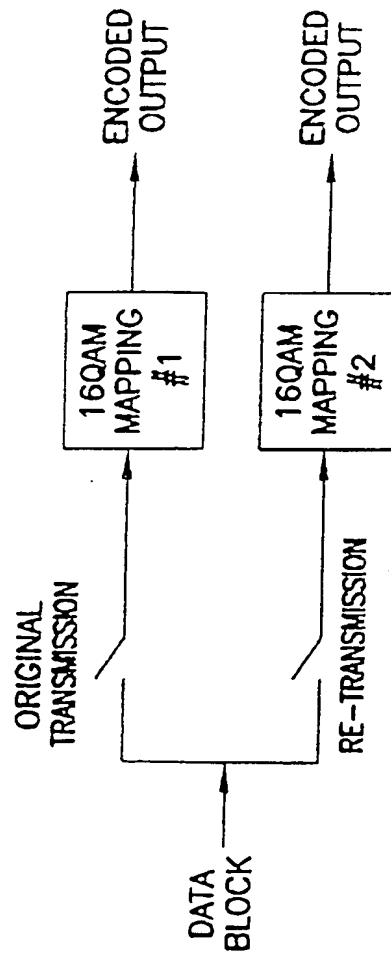


FIG. 11



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FIRST SYMBOL				SECOND SYMBOL			
A1	A2	A3	A4	C3	C1	C4	C2
B1	B2	B3	B4	A3	A1	A4	A2
C1	C2	C3	C4	D3	D1	D4	D2
D1	D2	D3	D4	B3	B1	B4	B2

FIG. 12A

FIRST SYMBOL				SECOND SYMBOL			
A1	A2	A3	A4	C2	C4	C1	C3
B1	B2	B3	B4	A3	A1	A4	A2
C1	C2	C3	C4	D2	D4	D1	D3
D1	D2	D3	D4	B3	B1	B4	B2

FIG. 12B

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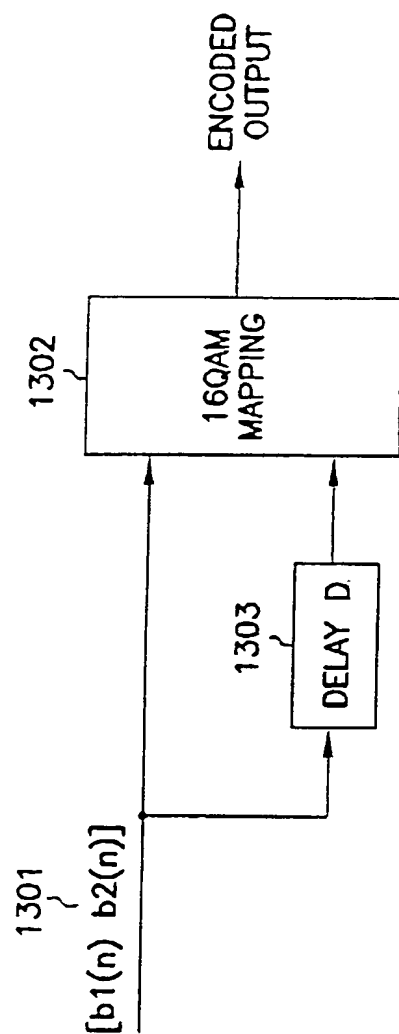


FIG. 13

0000	0001	0100	0101
0011	0010	0111	0110
1100	1101	1000	1001
1111	1110	1011	1010

FIG. 14

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 99/00227

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04N7/10 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04N H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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A	US 5 710 797 A (SEGAL MORDECHAI ET AL) 20 January 1998 (1998-01-20)	
	cited in the application	
	the whole document	
	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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- "&" document member of the same patent family

Date of the actual completion of the international search

16 August 1999

Date of mailing of the international search report

23/08/1999

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Authorized officer

Beaudoin, 0

# INTERNATIONAL SEARCH REPORT

Inter:      nal Application No

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